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# SCIENCE PROGRESS

A MONTHLY REVIEW OF CURRENT SCIENTIFIC INVESTIGATION

CONDUCTED BY  
HENRY C. BURDETT

EDITED BY J. BRETLAND FARMER, M. A.

WITH THE CO-OPERATION OF A CORPS OF ASSOCIATE EDITORS  
(See second page of cover.)

NOVEMBER, 1895

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WITH THE CO-OPERATION OF THE FOLLOWING EDITORIAL COMMITTEE:—

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definite composition, such as  $\text{AuCd}$ ,  $\text{Cu}_3\text{Sn}$  and others, many of which do not obey the ordinary laws of valency, may be held together rather after the fashion of double salts, may in fact be *molecular* and not *atomic* compounds. In this case they may be dissociated when in solution, but like the alums, exist in the solid form. Hence in a dilute solution of copper in tin, the copper may exist, as Heycock and Neville have shown, in the form of monatomic molecules, but yet when the mass solidifies the bodies  $\text{Cu}_4\text{Sn}$  and  $\text{Cu}_3\text{Sn}$  may be formed. It is certainly somewhat difficult to imagine that the electropositive and self-saturating atoms of gold and cadmium can be held together, in the molecule  $\text{AuCd}$ , by forces similar to those which maintain the equilibrium of a molecule of hydrochloric acid.

Future progress in this subject will probably be the reward of those who bring physical as well as chemical and microscopical methods to bear on the same problem.

F. H. NEVILLE.

## ANTHROPOMETRY IN INDIA.

GR<sup>E</sup>AT as are, and have been, the opportunities for anthropological research afforded by our Indian Empire, it can hardly be said that they have been utilised to anything like the extent that might have been the case. It is needless to dwell on the causes of this defect ; they are numerous but sufficiently clear ; and the parsimony of the Indian Government in matters relating to science is prominent among them.<sup>1</sup> But neither zeal nor industry have been wanting in European officials acting in their private capacity, and vast masses of ethnological material have been collected by them ; the department of physical anthropology has, however, been comparatively neglected, and what has been done therein up to a recent date has not been done systematically. Thus, for example, Dr. John Shortt, on the inspiration of Dr. Barnard Davis, so long ago as 1868, published a long series of measurements of the several tribes of the Neilgherry Mountains, and of certain castes in the plain of the Carnatic ; but he omitted to ascertain the length and breadth of the head ; and his observations, though valuable, are much less so than they might have been.

Here, as generally elsewhere, the earlier attempts to affiliate and classify the races of the country were based on language. History gave very little assistance ; in fact the Hindus can hardly be said to have had any history before the first onset of Mussulman conquest. But a rough division based on language was easily arrived at ; the Hindus to the north of the Vindhya were recognised as members of the great Indo-European family, and the occupants of the Deccan, with their Dravidian tongues, were supposed to be the descendants of the primitive population, pushed down into the peninsula by the Aryan

<sup>1</sup> Mr. Risley pleads in excuse of the incompleteness of his work in the Punjab the fact that the government of that province was too poor to assist in it.



conquerors. What were the elements and affinities of that primitive population remained, however, very doubtful; and the problem grew more complicated and difficult with a more complete knowledge of the numerous hill, forest, outcast, or servile tribes found not only in Southern and Central India, but even in the far north and north-east. It seemed doubtful whether these could really be the survivals of the organised and powerful peoples who were spoken of in the old Aryan literature as the hostile occupants of Hindustan. A not unpalatable idea, supported by the alleged presence of an outlying Dravidian language among the Brahuīs of Biluchistan, was that the best parts of India had been conquered from the aborigines long before the Aryan invasion by a Mongoloid or Turanian people, of whom the Brahuīs were the rear-guard. The aborigines might have been of some other type, perhaps akin to the Mincopies of Andaman, or of some other negroid stem. But some observers found Mongoloid features in them too. Dr. Shortt, certainly the most careful observer of the physical characteristics in the last generation, reported of the Kurumbas, a very degraded hill tribe in the Neilgherries, that they had "heads short from end to end, with a lofty crown or dome and prominent forehead, wedge-shaped faces, and obtuse facial angles, hollow cheeks, and prominent molar bones, the nose having a deep indentation at the root about  $1\frac{3}{4}$  inches in depth (!), which is general". The length of the nose from root to tip he found to be 1.75 inches, the breadth 1.42 nearly; from which we may fairly conjecture that the Kurumbas are, if not platyrrhine, at least very nearly so.

The value of these observations is impaired, for our present purpose, by the doubt whether the Kurumbas are not really a degenerate Dravidian tribe, once at a fair level of civilisation, rather than an aboriginal clan; but they are very interesting in relation to the Australioid hypothesis, of which more presently.

Again, with regard to the Yenadis, another outcast tribe of Madras, Shortt speaks of them as having a



Mongolian type of feature, with broad and prominent cheek-bones, a pointed chin, a scanty mustache, no whiskers, and a scanty straggling beard. Of nine skulls which he obtained, he says : " On a cursory view of these there is nothing remarkable among any of them ; they are somewhat small and light, and whilst the female skulls are uniform in contour (*i.e.*, I presume, dolichous, and oval or elliptic in the *norma verticalis*), the males have a great parietal width". Two of the female crania, which he presented to Barnard Davis,<sup>1</sup> are now in the museum of the College of Surgeons ; they are small and dolichous (cranial index, 70·9), and the zygomata are by no means wide. In fact it was clearly on the facial aspect and the scanty development of hair that Shortt founded any ideas he may have had of the Mongolian affinities of these outcasts, and these he was unable to put to the test of measurement, which, indeed, at that date had hardly begun to be applied to the face by anthropologists. Width of the cheek-bones is not necessarily accompanied by width of the zygomata, and is, of course, characteristic of other races besides those which we style Mongoloid or Turanian. It is very general among negroes and negroids ; and in relation to the breadth of the head even that of the zygoma is almost as often great in the black as in the yellow races.

But Huxley soon brought the search-light of his keen observation to bear upon the people of Southern India, with the result that he detected the resemblance existing between them and the Australians, with whose type he was familiar. The small long head, the deep nasal notch, the broad nose, the dark skin, the black wavy hair were characters which warranted him in denominating the Dravidians Australioids.

Strangely enough, very little has been done in Southern India since Shortt's time, in the way of extra observations ; but in East Central India the Kolarian tribes have been a good deal studied. The linguistic separation between Kolarians and Dravidians was sup-

<sup>1</sup> *Thesaurus Craniorum*, vol. i., p. 157.

posed to be accompanied by a difference of physical type; and the former were thought to be the descendants of Mongoloid immigrants from the north-east, the latter to be either the remains of an ancient oceanic population, or to have migrated from the north-west from the region where the Brahui had been left behind.

New light has been thrown on the subject, however, during the last few years by the investigations made by Mr. H. H. Risley, with governmental authority and support, into the anthropometry of the Bengal presidency.

The ethnology of this part of India—the valleys, roughly speaking, of the Ganges and the middle Indus—had never appeared so difficult as that of the peninsula, though it had its own complexities, and the absence of historical data was almost as deplorable. The prevailing view was that the primitive Aryans, entering the plain of the Indus from the north-west, had gradually spread eastwards, conquering and civilising until they had occupied almost the entire tract. Some, those who made light of colour and complexion as permanent racial characteristics, supposed that the whole population was of Aryan descent more or less pure, and this view was naturally not unwelcome to the educated and patriotic Hindu. Others believed that the twice-born castes, the Brahmans, Kshatriyas and Vaisyas, were truly Aryan, the Sudras, or mass of the population, being descended from the conquered Dasyus, the ancient occupants, more or less leavened, perhaps, by a tincture of the blood of the superior race. It was natural, also, to suppose that, in accordance with the usual rules of migration and conquest, the proportion of the blood of the invaders would be found greatest in the neighbourhood of the scene of their arrival, on the north-western frontier, that is, and in the Punjab; though the distribution would no doubt be modified to some extent by the greater or less attractions of the soil in the several provinces; thus aboriginal tribes were known to have subsisted in force till a late period in the arid hills and plains of Rajputana, and in the forest tracts of Central India, whereas the Doab of the

Ganges and Jumna had since the dawn of history, and doubtless long before, been the aim and coveted possession of every invading tribe, Iranian or Turanian, Greek, Pathan, Turk or Mongol.

Different theories of caste complicated the subject. Caste means colour, and the prevailing opinion was that of the Hindus themselves, that the origin of castes was in the distinctions of races who differed physically and palpably. Their great multiplicity was ascribed partly to breach of laws of endogamy by cross-breeding. Thus the Ambastha, or physician caste, was supposed to descend from the intermarriage of Brahmans with Vaisyas. On this theory, however, there is a little difficulty in perceiving why a particular cross-breed should have been confined to a particular occupation, and there were those who preferred to assign the origin of caste distinctions to difference of occupation rather than of blood, and who thought the prohibition of exogamy was of later date. There are, indeed, indications that these prohibitions were not so absolute or so strictly adhered to at some remote period as they have been now for many ages; and it will be found that this will furnish an almost necessary explanation of certain general resemblances in the provincial populations.

Mr. Risley, taking his method and instructions from Topinard and Flower, and using chiefly native assistants, who appear to have carried out their work with great intelligence and zeal, ascertained the stature and weight, and the principal cephalic and facial measurements in a considerable number of individuals of each of 87 castes or tribes, of which 15 belonged to the province of Bengal, 5 to Chittagong, 10 to the Darjiling Hills, 10 to Behar, 17 to Chota Nagpur, 23 to Oudh and the north-west provinces, and 9 to the Punjab. In a good many cases he succeeded in getting 100 subjects of each caste, but most of those in the Punjab, and some in the other provinces, are but insufficiently represented. The total number of persons examined was nearly 6000.

The chief inferences which Mr. Risley drew from this

extensive investigation were, first, that the castes are, generally speaking, really ethnological and not merely social divisions; second, that three main types may be distinguished in the population of India at the present day.

1. A leptorhine (long-nosed), pro-opic (*i.e.*, hatchet-faced, or as the Chinese say of us, horse-faced), dolichokephalic type, of tall stature, light build, narrow face, comparatively fair complexion, and high or open facial angle. This type is most marked in the Punjab. Their exogamous groups are eponymous, names of Vedic saints or heroes.

2. A platyrrhine, mesopic or nearly platyopic, dolichokephalic type, of low stature, thick-set, with very dark complexion, broad face, and usually low facial angle; most distinct in Chota Nagpur and the central provinces. Its sections are totemistic, names of animals, plants, etc., to all of which some form of taboo applies.

3. A mesorhine, platyopic, brachykephalic type, of lower medium stature, sturdy build, yellowish complexion, broad face, and low facial angle; found along the northern and eastern frontiers of Bengal. Exogamous groups curiously named, mostly by nicknames of supposed founders.

Of these the first is evidently the Aryan type, the type, that is, which has from time to time filtered in from the north-west across the Indus. Except in colour, it recalls the tall blonde type of Northern Europe; except in stature, perhaps, as Topinard suggests, the dark Mediterranean type. The dolichokephaly is probably inherent in the immigrant stock, not acquired by admixture with the black Australioids, for it is as strong among the Punjabis (abstraction having been made of the trans-Sindhian Pathans and Biluchs) as anywhere, and would not, in the Sikhs and Gujars, exceed 71 in the bare skull. It exists, moreover, in an exquisite degree among the north-western mountains, in the Cashmiris, the Dards, and Chitralis, people who, from their position in the direction of the supposed fountains of migration, should be more Aryan than the most

Aryan Hindus, should be in fact to them what the Holsteiner or Frisian is to the Englishman.

These Dards, be it noted, though a few among them may be blonde, seem to be generally dark-eyed and dark-haired; and the same seems to be the case with the Kafirs of the Hindu Kush.

Topinard in his commentary on Risley's tables hints his surprise at the smallness of the influence which the Turanian conquerors (Turks, Mongols, perhaps Saka) have had in raising the kephalic index. It seems to me that these invaders, in the historical period at least, usually crossed the Punjab to settle in the richer valley of the Ganges. It is true that there is no indication of them in Risley's figures for the north-west provinces, either; but then he has not included the up-country Mussulmans, Moguls, Rohillas, etc., in his observations, which seems to be an unfortunate omission.

Another thing which some may regret is the exclusion from the scheme of any observations on colour. Mr. Risley appears to have been unacquainted with Broca's colour-scale (which, though not applicable to the hair, is fairly good for the skin), and to have thought that no easily workable system of colour-observation existed.

The Punjabis are, as is generally known, strikingly superior in stature to the people of other parts of India. Of 80 Sikhs measured the range was from 165 to 190 centimetres (65 to 74·8 inches), and the average 171·6 (67·5 inches); and the lowest average for a single caste in the Punjab (165·8 for the Aroras) surpasses the highest for any caste in Bengal (165·6 for the Brahmans). In weight, however, they fall below the burly mountaineers of Sikkim; and even among the stunted hillmen of Chota Nagpur there is one tribe, the Munda, which excels them. The proportion of weight to height varies, therefore, very remarkably, from 372 in the Mundas to 290 in the Khattris of Oudh, a caste supposed to have a strong Aryan element, the average for the whole of Bengal being apparently 308. On the whole the tall slender frame seems to characterise the partly-Aryan Hindu to-day, as it did in the Vedic period, when his

supposed ancestors derided the stumpy, noseless, black aborigines ; still, it may be that differences in elevation of habitat have exerted some influence.

Other and more unequivocal characteristics seem to be those derivable from the breadth of the nose, and somewhat less positively from the naso-malar index of Flower and Oldfield-Thomas, on both of which great stress is laid by Risley, whose figures seem to bear out his opinion.

The average nasal index of the Punjabis comes out at 70·2, just on the limit of the leptorhine and mesorhine class, but the Sikhs, Pathans, and Biluchs are actually leptorhine, and the index for the Goojurs, the very interesting pastoral caste of the Punjab, is as low as 66·9 ; unfortunately only 13 Goojurs could be examined. These figures are perfectly European.<sup>1</sup>

The nasal index does not, as might perhaps have been expected, increase with anything like regular progression as we advance eastwards from the Punjab ; but it does increase, and that considerably. Something should perhaps be allowed for the fact that a partly arbitrary, partly fortuitous selection of castes cannot be relied on to give the absolute means of the whole population ; and something, certainly, for the personal equation of the observers ; for the exact measurement of the nose is one of the most difficult bits of anthropometry. But it seems strange that Risley's Bengalis yield a nasal index of 78·7, his Bēharis one of 80, and his men of the upper Ganges (Oudh, etc.) one of 80·9. Similarly, his Brahmans of Bengal give us 70·4, those of Bēhar 73·2, those of the upper Ganges 74·6. Can it be that there is actually a larger Aryan element in Bengal than in the country between there and the Sutlej ? That seems very improbable. On the other hand, the Mongoloid brachycephalic people of the Darjiling Hills have a comparatively low mesorhine index—only 74·7 on an average, and the Lepchas of Sikkim are positively leptorhine, while the people of the Chittagong Hills have a mesorhine index of 82·7, not nearly so high as that of the more dolichous

<sup>1</sup> I found the nasal index 69·1 in 50 Englishmen, mostly of the upper class.

hillmen of Chota Nagpur (87·4). The low-caste men of Bengal proper have a less prominent nose root (which is a simpler way of saying a smaller naso-malar index, 111·7 to 113·8) than those of Bēhar; though more prominent than the people of the Chittagong Hills, of Sikkim, and the Himalaya, or than them of Chota Nagpur, which facts, on the other hand, would seem to imply a greater infusion of Aryan blood in Bēhar than in Bengal. The Chota Nagpur people again are not quite so flat faced as—have a rather more prominent nose root than—the Chittagongers and Sikkimites (110·4 to 107·1 and 108·6). And lastly, the Bengalis approximate somewhat to the last-mentioned tribes in kephalic index, the order in that respect being as follows:—

|               |                     |                 |        |
|---------------|---------------------|-----------------|--------|
| Oudh, etc.,   | - 72·8 <sup>1</sup> | Bengal, -       | - 76·9 |
| Punjab, -     | - 74·2              | Chittagong, -   | - 79·9 |
| Chota Nagpur, | 74·9                | Sikkim, etc., - | - 80·7 |
| Bēhar, -      | - 75·7              |                 |        |

and the high average of the Bengalis not being due to the low-caste men included; for it affects both high and low, the very highest averages being those of the Brahmans (78·7), the Kayasths (the writer caste, of doubtful origin but high in rank) (78·3), and the Chandals, a very low caste (78·1). The average of the Brahmans of Bēhar is only 74·9, and that of those of Oudh and the north-west 73·1 apparently.<sup>2</sup>

Here seems to be a kind of crux. The most likely ways out of it are the following, for some of the discrepancies seem beyond the possible range of the personal equation.<sup>3</sup>

<sup>1</sup> See further on.

<sup>2</sup> This is possibly an under-statement; see further on.

<sup>3</sup> Mr. Risley's figures, having so wide a basis, need no confirmation except with reference to the possible interference of the personal equation. I may mention, however, that five Bengali Brahmans and Kayasths, whom I measured long ago, yielded an average index of 80·3. The measurements in Barnard Davis's *Thesaurus*, a great many of which refer to the crania of natives of Dacca in Eastern Bengal, are also corroborative. Davis mentions a very important point, that Bengali skulls are often obliquely deformed, probably from some peculiarity in the way of nursing: this may perhaps a little exalt the index.



Either (1) the case must be put down to the credit of the transformists, and we must suppose that the influence of media in Bengal tends towards brachycephaly. The only influence of the kind I can suggest is that of the drinking water, which in that great alluvial plain may be deficient in calcareous salts.

Or (2) we must suppose that the views of Col. Dalton and his followers are so far correct that there was at some time or times anterior to history a considerable immigration into Eastern India from the north and east, consisting of course of brachycephals, who would permanently modify the cranial form of the inhabitants of Bengal proper, but who did not push forward into Orissa and Chota Nagpur in sufficient numbers or force to produce any permanent effect on the prevailing type there.

Not that this hypothesis (which, by the way, seems to be favoured by Mr. Risley)<sup>1</sup> is not free from very strong objections. Thus, it is generally supposed, and claimed by themselves, that the Bengali Brahmans have been strictly endogamous at least since their arrival in their present seats, whither indeed the immigration of some of their sub-sections is asserted to have been comparatively recent. We can but suppose that during the period when Buddhism had sway in Bengal its doctrine of equality prevailed to break up for the time the Brahman law of endogamy, which was re-established and made strict, and society reorganised, on the downfall of that faith. Thus only, too, can we account for a degree of family likeness in most of the Bengali castes, the despised Chandals, for example, coming out with dimensions not much unlike the lordly Brahmans.

We pass next to the second type, which may be shortly named Negroid. Mr. Risley would call it Dravidian, but this seems hardly justifiable as yet, until we know through more numerous and exact observations in other parts of the great region which is Dravidian in language, that this is

<sup>1</sup> Marco Polo gives an interesting account of the victory of Kublai Khan over the King of Mien (Burmah) and Bangala, about 1280 A.D. ; but we cannot be confident that the Burmese were really the lords of Bengal at that period.

really the type generally distributed through it. As yet we can only say that certain low or outcast tribes in the south seem to resemble those of Chota Nagpur, whether Kolarian or Dravidian in language, which have been examined. Ceylon is the only portion of the great south where a Sanskritic tongue prevails, and though it is always dangerous to argue from language to race, it is tolerably safe to say that if at any one time and in any one province of the south an Aryan colony had settled in numbers anything like equal to those of the natives, they would have succeeded in importing and transmitting their language. It is on the whole, then, improbable that anywhere in the peninsula Aryan blood predominates; yet we are told that in many parts the prevailing type is handsome and neither Mongoloid nor Negroid or Australioid in aspect.<sup>1</sup> It is best to suspend our judgment as to the component elements of these southern people.

The nasal index is the most characteristic point in the measurements of this type. In the valley of the Ganges, except in Bengal proper, it seems to be the invariable rule that a high caste is distinguished from a low one by the smaller breadth of the nose. Of course this is true only *en masse*, and not always in the individual; even in the Sikhs, reputed (I believe) an extremely homogeneous tribe, this index varies from 55 to 82. Of the naso-malar index I am not disposed to think so highly, at least in its application to the living. The Chandals in Bengal, and the Doms in Chota Nagpur, come out by that test better than the Khatri of the Punjab. It must also be very difficult in practice. But, as Topinard says, it is well worthy of further trial.

The third type is the one usually recognised as Mongoloid or Turanian, and is prevalent in two of Risley's districts, the Darjiling Hills (*i.e.*, Sikkim and its neighbourhood), and the Chittagong Hills to the east of Bengal. The northern people are taller and considerably heavier

<sup>1</sup> The Todas of the Neilgherries, for example, who are tall, handsome in feature, and evidently not platyrrhine, yet with but little except their physical aspect to dissociate them from other Dravidian-speaking tribes.

than the eastern, but in other respects no great differences appear in Risley's tables, except that his frontozygomatic index (the proportion borne by the minimum breadth of the forehead to the maximum of the zygomata taken as 100) is larger in Sikkim than in Chittagong as 76 to 74. Topinard, in his masterly review of Risley's work, objects to this index as of little value, because the minimum frontal breadth gives little or no indication of the breadth of the frontal lobe. The really valuable index, as he shows, is got by comparing the stephanic or maximum frontal breadth with the zygomatic. But in the living subject this is extremely difficult; and though I myself employ Topinard's index with profit, I am conscious that my data are often wide of the fact. On the other hand the fronto-minimal plan is easy though untrustworthy, and on the whole and in the main, or in a certain number of cases, does point in the desired direction. Thus the index so gotten singles out the Brahmans from the other Bengalis (82·4, the next in order being the respectable caste of Kayasths with 79·3), and thus brings them into line with the nine Punjabi castes or tribes, who with the exception of the Kachis in the N.W. Province are the only ones which rise above 80. Both sections of Mongoloids have faces longer as well as broader than Hindus, whence the vertico-kephalic index, or proportion of the maximum breadth to the total height of the head (chin to vertex), is not very significant.<sup>1</sup> And I cannot help entertaining serious doubts of the entire trustworthiness of the figures for Oudh and the N.W. Province, in which I seem to detect a marked personal equation,

|                   | <sup>1</sup> Length of Head. | Breadth of Head. | Height of Head and Face. | Height of Forehead (vertex to inter-superciliary point). | Ear Height. |
|-------------------|------------------------------|------------------|--------------------------|--|-------------|
| Punjab - - - -    | 187                          | 139              | 218                      | 86   | 135         |
| Sikkim - - - -    | 184                          | 149              | 220                      | 82   | 135         |
| Chittagong - - -  | 182                          | 146              | 218                      | 83   | 135         |
| Bengal - - - -    | 183                          | 141              | 208                      | 76   | 129         |
| Chota Nagpur - -  | 185                          | 139              | 208                      | 79   | 127         |
| Béhar - - - -     | 185·4                        | 141              | 208                      | 78   | 129         |
| Oudh & N.W. Prov. | 185                          | 135              | 222                      | 99   | 127         |

operating in the direction of an exaggeration of the vertical height and probably also a diminution of the breadth of the head. Thus, if we compare, in the adjoining provinces of the north-west and of Bēhar, castes identical in name, and, we may presume, nearly identical in blood, we get the following results :—

|             |                 |   | Length | Breadth | Vert.<br>Height | Do.,<br>Forehead | Ear<br>Height |
|-------------|-----------------|---|--------|---------|-----------------|------------------|---------------|
| Brahman -   | { Bēhar - -     | - | 187·8  | 140·8   | 214             | 83·7             | 132           |
|             | { Oudh and N.W. | - | 187·5  | 137·2   | 223             | 103·3            | 130·4         |
| Babhan -    | { Bēhar - -     | - | 187·8  | 144·4   | 214             | 80·7             | 132           |
|             | { Oudh and N.W. | - | 187·2  | 137·4   | 222             | 99               | 129·5         |
| Goalà -     | { Bēhar - -     | - | 185·4  | 141·4   | 209             | 78               | 130           |
|             | { Oudh and N.W. | - | 185·2  | 135·2   | 217             | 96·7             | 127           |
| Chamar -    | { Bēhar - -     | - | 184·4  | 140·3   | 205             | 76               | 129           |
|             | { Oudh and N.W. | - | 185·1  | 134·9   | 221             | 99               | 127           |
| Musahar -   | { Bēhar - -     | - | 183    | 138·6   | 202             | 73               | 127           |
|             | { Oudh and N.W. | - | 181·7  | 134·8   | 214             | 92               | 130           |
| Mean of 5 - | { Bēhar - -     | - | 185·7  | 141·1   | 209             | 78·3             | 130           |
|             | { Oudh and N.W. | - | 185·3  | 135·9   | 219             | 98               | 128·8         |

Here the correspondence of the figures in the first and fifth columns is so close that the wide discrepancies in the second, third, and fourth columns become almost incredible ; and as they invariably run in the same directions of less breadth and greater height, for the castes of Oudh, etc., one is almost irresistibly led to attribute them, at least in part, to the personal equation of the observer. It is not difficult to conceive the habitual error in the *horizontation* of the head, which has led to the errors in the third and fourth columns : in the second the fault, if fault there was, lay probably in measuring at the spots where the maximum breadth might be expected to be, instead of groping about to find the maximum.<sup>1</sup> I see no internal evidence to lead one to distrust the other measurements, but of course all the indices for Oudh and the N.W. Province, into which the vertical height enters as an element, must have come out too small.

The very extensive distribution of some of the castes supplies an argument against the ethnological explanation

<sup>1</sup> Or it may be that the Oudh operator put a little more pressure on the callipers than did his fellow-workers. The frontal and bizygomatic measurements for Oudh, etc., are smaller than those for Bēhar, but not beyond the limits of likelihood.

of caste. Thus the Doms are found by name not only in the Gangetic provinces, in Chota Nagpur, and (I believe) in Orissa, but also in the far south, about Madras. And their occupations in these different localities seem sufficiently alike to lead one to identify them as, at least, the same caste everywhere. Are we to suppose that their wide spread is due to migration? In the case of the Brahmans and of the military castes or races, one would have no difficulty in believing this; but does it not seem difficult in the case of Helots like the Doms?

The study of the nasal index is enough by itself to make me believe in the racial origin of the system; but it seems quite possible that castes were formed subsequently by the comradeship of people of like occupation. In recent times and in our own day, castes would have been and are being formed out of aboriginal tribes low in the scale of civilisation or social status; and of this Mr. Risley gives many interesting and sometimes amusing instances. The chiefs of such a tribe almost invariably endeavour to hang themselves on to some branch of the Rajputs; while the proletariat constitute a new caste, for which an Aryan ancestry is sometimes claimed. Outcasts from higher castes are sometimes received into lower ones; and this may be one of the ways in which a circulation of blood has been set up, so as slightly to assimilate the various sections of the population.

The small average size of Hindu heads is remarkable. It comes out very distinctly in Barnard Davis's *Thesaurus*, as does their inferiority in this respect to those of the Mongoloid races to the north and east of their habitat. Even the Punjabi heads are not large, nor apparently those of the dolichous tribes north-west of the Indus, Dards, Kafirs, etc., of whom Leitner, Garson, and others have written. Admixture of Dravidian or Australioid types could only be expected to lower the cranial capacity; admixture of Mongoloid ones might possibly counterbalance this. Mr. Risley's facts seem to follow these rules. I have constructed a table of comparative sizes by multiplying in every case the maximum length by the maximum breadth,

and that by the ear height. A trifle less than two-fifths of the product would probably give the cranial capacity in cubic centimetres.<sup>1</sup>

Relative size of head in the several provinces :—<sup>2</sup>

|                         |   |   |      |                       |   |   |      |
|-------------------------|---|---|------|-----------------------|---|---|------|
| Brahmans, Bengal        | - | - | 3474 | Pathans, Punjab       | - | - | 3626 |
| Kayasths, „             | - | - | 3394 | Goojurs, „            | - | - | 3602 |
| Province, „             | - | - | 3347 | Province, „           | - | - | 3521 |
| Bagdis, „               | - | - | 3277 | Chuhars, „            | - | - | 3393 |
| Babhans, Bēhar          | - | - | 3653 |                       |   |   |      |
| Brahmans, „             | - | - | 3496 | Cheros (Ch. Nagpur) - | - | - | 3544 |
| Province, „             | - | - | 3384 | Province „            | - | - | 3346 |
| Musahars, „             | - | - | 3218 | Bhuiyas „             | - | - | 3229 |
| Brahmans, N.W. and Oudh |   |   | 3347 | Sikkim Province       | - | - | 3726 |
| Chhetris, „             |   |   | 3342 | Chittagong Province   | - | - | 3585 |
| Babhans, „              |   |   | 3330 |                       |   |   |      |
| Kayasths, „             |   |   | 3239 |                       |   |   |      |
| Province, „             |   |   | 3197 |                       |   |   |      |
| Kols, „                 |   |   | 3083 |                       |   |   |      |

Here the brachykephals surpass the dolichos, the Aryans the aborigines, the upper surpass the lower castes. But the Brahmans, despite their claims to be considered a kind of intellectual aristocracy, do not seem to surpass the other high-caste men, unless it be in the dimensions of the forehead; and the Kayasths or writers, almost all of whom live by their brains and their pens, do not stand very much above the average. These differences are not inconsiderable; they exceed probably those which obtain between the superior and inferior classes in our own country; but I do not think they yield any evidence in support of the inheritance of acquired characters.

<sup>1</sup> Thus: high-caste men (chiefly Bengali), 72 cubic inches capacity; low-caste men, 71; Central India, 64.5; Lepchas (Sikkim), 73.8; Bodos, 75.5; Bodpas, 76.5; Mishmis, 77; Thai (Siamese), 77.6. (B. Davis.)

<sup>2</sup> The Chhetri (Rajputs), Babhans, Goojurs, have strong claims to be considered largely Aryan. The Kayasths, or writer caste, though now high in rank, are probably much less so. The Cheros were anciently a royal race. The Bagdis, Bhuiyas, Kols and Musahars (hunters) are distinctly aboriginal. The Chuhars are a helot caste.

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JOHN BEDDOE.



## THE PRESENT POSITION OF FLORAL BIOLOGY.

DURING the last twelve months several important books and papers (1) dealing with the natural history of the flower have been published, and it may be well at this period to review our position, and also to endeavour to trace the general ideas that hold sway in this department of knowledge. The republication of C. K. Sprengel's *Entdeckte Geheimniss der Natur* (1793) enables any one easily to compare our present knowledge with his, and it is rather humiliating to find how very little we have advanced in the direction of deeper understanding of floral phenomena. We have indeed accumulated a stupendous mass of details, but except that for Sprengel's old-fashioned teleology we have substituted the modern one based upon evolution, invoking "adaptation" where he refers to "design of nature," we are really not much further forward. The chief advances made have been effected by Darwin and by H. Müller, who have given us the "Knight-Darwin-Müller hypothesis" and the "Theory of Flowers". No branch of biology has suffered more than that under consideration, from the pushing to extremes of the adaptation idea. The dangers of this course have often been pointed out, and in other branches not without good effect; but a perusal of almost any work upon floral biology will show that here at least, adaptation is made to explain almost everything; biological meanings are forced into every detail of floral structure, often without any evidence whatever. The fact that the subject is so admirably suited for popular treatment, is probably responsible for much of this.

Rather than confess that we do not know the meaning of a particular structure or phenomenon, we give a glib "explanation" by saying that it is an adaptation to something. So far has this gone, that even among professional botanists there is an idea, perhaps unconscious, that the subject is exhausted and affords no room for good research,



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